

Physics 110 Constants and Equations (Fall 2002)

Constant	Symbol	Value	Constant	Symbol	Value
Acceleration due to gravity	g	9.8 m/s^2	Mass of a proton	m_p	$1.007\,276 \text{ u}$
Gravitational constant	G	$6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$	Mass of a neutron	m_n	$1.008\,665 \text{ u}$
Speed of light	c	$3 \times 10^8 \text{ m/s}$	Mass of an electron	m_e	$0.000\,548 \text{ u}$
Boltzmann's constant	k	$1.38 \times 10^{-23} \text{ J/K}$	Mass of Earth	M_{earth}	$5.97 \times 10^{24} \text{ kg}$
Universal gas constant	R	8.31 J/K mol	Mean distance from Sun	1 AU	$1.5 \times 10^{11} \text{ m}$
Electron-volt	eV	$1.60 \times 10^{-19} \text{ J}$	Radius of Earth	R_{earth}	$6.37 \times 10^6 \text{ m}$
Unified mass unit	u	931.5 MeV/c^2	Unified mass unit	u	$1.66 \times 10^{-27} \text{ kg}$

Definitions

$$v_x = \frac{dx}{dt}$$

$$a_x = \frac{dv_x}{dt}$$

Kinematics (constant acceleration)

$$x = x_0 + v_{x0}t + \frac{1}{2}a_x t^2$$

$$v_x = v_{x0} + a_x t$$

$$v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$$

$$x = x_0 + \frac{1}{2}(v_{x0} + v_x)t$$

Newton's Second Law and Forces

$$\vec{F}_{\text{net}} = \sum \vec{F}_{\text{ext}} = m\vec{a} = \frac{d\vec{p}}{dt}$$

$$F_k = \sum_k N \quad F_s = \sum_s N$$

$$F_D = Dv^2$$

$$\vec{W} = mg \quad F = \sum kx$$

$$F = \frac{Gm_1m_2}{r^2} = \frac{GMm}{r^2}$$

Curvilinear Motion

$$a_r = \frac{v_t^2}{r} = \sum r^2 \vec{r}$$

$$v_t = \sum r$$

$$a_t = r\sum$$

Work and Energy

$$W = \int_1^2 \vec{F} \cdot d\vec{r} \quad \sum K = W_{\text{net}}$$

$$K = \frac{1}{2}mv^2 \quad P = \frac{dW}{dt}$$

$$F_x = \sum \frac{dU}{dx} \quad \sum U_{A \rightarrow B} = \int_A^B \vec{F} \cdot d\vec{r}$$

$$\sum E = \sum K + \sum U = W_{\text{nc}}$$

$$E = K + U$$

Vector Identities

$$\vec{A} \cdot \vec{B} = |\vec{A}| |\vec{B}| \cos \theta$$

$$|\vec{A} \times \vec{B}| = |\vec{A}| |\vec{B}| \sin \theta$$

Potential Energy

$$U_g = mgh$$

$$U_g = \sum \frac{Gm_1m_2}{r} = \sum \frac{GMm}{r}$$

$$U_{\text{spring}} = \frac{1}{2}kx^2$$

Circular Orbits

$$E = \frac{1}{2}U = -K \quad T = \frac{2\pi}{v}$$

Kinetic Theory of Gases

$$P = \frac{F}{A} \quad PV = NkT \quad PV = nRT$$

$$\frac{1}{2}mv^2 = \frac{3}{2}kT$$

Law of Atmospheres

$$n(y) = n_0 e^{\frac{-mgy}{kT}} \quad P(y) = P_0 e^{\frac{-mgy}{kT}}$$

Rockets

$$\vec{T} = \sum \vec{V}_{\text{ex}} \left| \frac{dM}{dt} \right|$$

$$v_f = v_i + V_{\text{ex}} \ln \left| \frac{M_i}{M_f} \right|$$

Impulse and Linear Momentum

$$\vec{I} = \int_{t_1}^{t_2} \vec{F} dt = \sum \vec{p}$$

$$\vec{p} = m\vec{v} \quad \sum \vec{p}_i = \sum \vec{p}_f$$

Rotational Dynamics

$$\sum = \frac{d\vec{\theta}}{dt} \quad \sum = \frac{d\sum}{dt}$$

Rotational Kinematics (constant angular acceleration)

$$\sum = \sum_o + \sum_o t + \frac{1}{2}\sum t^2$$

$$\sum = \sum_o + \sum t$$

$$\sum^2 = \sum_o^2 + 2\sum(\sum \sum_o)$$

$$\sum = \sum_o + \frac{1}{2}(\sum_o + \sum) t$$

Torque

$$\sum = \vec{r} \times \vec{F}$$

$$\sum_{\text{net}} = \sum \sum_{\text{ext}} = I\sum = \frac{d\vec{L}}{dt}$$

Rotational Inertia/Moment of Inertia

$$I = \sum_i m_i r_i^2$$

Angular Momentum

$$\vec{L} = \vec{r} \times \vec{p} = I\vec{\omega}$$

$$\sum \vec{L}_i = \sum \vec{L}_f$$

Simple and Damped Harmonic Motion

$$f = \frac{1}{T} = \frac{\sum}{2\pi}$$

$$\omega = \sqrt{k/m}$$

$$\ell = \sqrt{g/k}$$

$$x(t) = A \cos(\omega t + \phi)$$

$$F_d = b v$$

$$x(t) = A e^{\frac{-bt}{2m}} \cos(\omega t + \phi)$$

Wave Motion

$$v = \frac{\sum}{T} = \frac{\sum}{\lambda} = \frac{\omega}{k}$$

$$v = \sqrt{F/\rho}$$

$$k = \frac{2\pi}{\lambda}$$

$$y(x,t) = A \cos(kx \pm \omega t)$$

Relativity

$$\sum = \frac{1}{\sqrt{1 - v^2/c^2}}$$

$$\sum t = \frac{\sum t}{\sqrt{1 - v^2/c^2}}$$

$$\sum x = \frac{\sum x}{\sqrt{1 - v^2/c^2}}$$